

PHILOSOPHICAL TRANSACTIONS.

August 19. 1672.

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An Extract of a Letter of M. Hugen to the Author of the Journal des Scavans of July 25. 1672. attempting to render the Cause of that odd Phenomenon of the Quicksilvers remaining suspended far above the usual height in the Torricellian Experiment.

THE Experiment is briefly this; That a Tube, being, after the Torricellian way, filled with Mercury, and before inversion perfectly purged of Air, doth, when inverted,

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remain

remain top full, even to the height of 75 inches.

M. *Hugens*, to render a probable cause of this strange effect, conceiveth, That, besides the pressure of the Air, which keeps the Mercury suspended at the height of about 27 inches, and of the truth of which we are convinced by a great number of other effects that we see; there is yet another pressure, stronger than that, of a more subtile matter than Air, which without difficulty penetrates glass, water, quicksilver, and all other bodies, which we find impenetrable to Air. This pressure, *he saith*, being added to that of the Air, is capable to sustain the 75 inches of Mercury, and possibly more, as long as it works only against the lower surface, or against that of the Mercury, in which stands the open end of the tube: But as soon as it can work also on the other side, (which happens when striking or hitting against the tube, or intromitting into it a small bubble of Air, you give way to this matter to begin to act) the pressure of it becomes equal on both sides, so that there is no more but the pressure of the Air, which sustains the Mercury at the ordinary height of 27 inches.

If you ask, why the Quicksilver in the Tube of this Experiment does not feel the pressure of this matter, even whilst that vessel is yet full; since M. *Hugens* supposeth, that it pierceth without difficulty the Glass as well as the Mercury, &c? And why the particles of this matter do not joyn together and begin the pressure, in regard that they go and come thorow the whole extent of the Mercury, and that the Glass does not hinder their communication with those that are without:

To remove this difficulty, which in M. *Hugen's* own opinion is very great, he answers, That though the parts of the matter, by him supposed, do find passage between those that compose the glass, quicksilver, &c; yet they there find not sufficiently large ones for many to pass together, nor to move there with that force which is requisite to separate the parts of the quicksilver, that have some connexion together. And this very same connexion, *he saith*, is the cause, that though on the side of the inner surface of the glass, which touches the suspended Mercury, many of its parts be pressed by the particles of this matter; yet there being also a great number of them, that feel no pressure by reason of the parts of the
glass,

glass, behind which they are placed; they retain one another, and they remain all suspended, because there is much less pressure on the surface of the quicksilver that is contiguous to the glass, than upon that below, which is all exposed to the action of that matter which makes this second pressure.

The ingenious and candid Author of this solution acknowledges himself, that it doth not so fully satisfy him as not to leave some scruple behind; but then he adds, that that keeps him not from being very well assured of that new pressure, which he hath supposed besides that of the Air, by reason as well of the Experiment already alledged, as of two others, which he subjoins to this effect;

First, When two plates of mettall or marble, whose surfaces are perfectly plain, are put one upon another, they do so stick together, that the uppermost being lifted up, the undermost follows without quitting it: And the cause hereof is justly ascribed to the pressure of the Air against their two external surfaces. He taking then two plates, each of them but about an inch square, being of that matter, of which anciently they made Looking-glasses, and closing so exactly together, that without putting any thing between, the uppermost keeps not only up the other, but sometimes also with it three pounds of lead fasten'd to the lowermost, and thus they remain together as long as you please. Having thus joyned them and charged them with three pounds weight, he suspended them in the Recipient of his Engin, and exhausted it of Air so far as that there remained not enough to sustain by its pressure as much as an inch high of water; and yet his plates disjoyned not. He adds, that he made the same Experiment by putting Spirit of Wine between the two plates; and found, that in the Recipient evacuated of Air they sustain'd, without being sever'd, the same weight they did when it was full of Air. This, he thinks, shews clearly enough, that there remains yet in the Recipient a pressure great enough after that of the Air is thence taken away; and that there is no more reason to doubt of it, than of the pressure of the Air it self.

The *Second* Experiment is, That whereas the effect of a siphon of unequal legs, by which you make the water of a vessel to run over, is no longer ascribed to a *fuga vacui*, but

to the weight of the Air, which pressing upon the water of the vessel makes it rise in the siphon, whilst on the other side it descends by its weight; *M. Hugen*s found a means to make the water of the siphon run, after that the Recipient was exhausted of Air, and he saw, that with Water

** M. Hugen hath made the Experiment, the Cause of which is here considered, as well with Water as with Mercury.*

purged of Air * it did the effect as well as without the Recipient. The shortest of the legs of the siphon was eight inches long, and its aperture, of two lines. And he will not have us doubt, whether the Recipient was well exhausted of Air; for he did assure himself of that, as well by finding that there came out no more Air through the pump, as by other more certain marques.

And this he takes for a further confirmation of his supposition of a pressing matter more subtile than the Air. To which he adds, that, if you take the pains of searching, to what degree the force of this pressure reacheth, (which he saith cannot be better made than by pursuing the Experiment with Tubes full of Mercury yet longer than those employ'd by *M. Boyle*,) it will perhaps be found, that this force is great enough to cause the *Union* of the parts of Glass and of other sorts of bodies, which hold too well together as not to be conjoyned but by their contiguity and rest, as *M. Des-Cartes* would have it.